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AUTHOR Reeves, Thomas C.
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ABSTRACT

This paper provides a response to serious critics of media and technology in education. It concludes: (1) media and technology are best used as cognitive tools to learn rather than as surrogate teachers; (2) media and technology are only vehicles for the content and pedagogy that educators design into them; and (3) future efforts to integrate media and technology into education must be guided by stronger research and evaluation. Following an introduction that summarizes federal government support for media and technology in education, the author responds to the doubts expressed in the following publications by three vocal critics of media and technology in education: "Future Schlock: Using Fabricated Data and Politically Correct Platitudes in the Name of Education Reform" (Lawrence Baines, 1997); "The Computer Delusion" (Todd Oppenheimer, 1997); and "The End of Education: Redefining the Value of School" (Neil Postman, 1995). Contains 17 references. (Author/DLS)

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Answering Critics of Media and Technology in Education

Thomas C. Reeves, Ph.D.
Instructional Technology, The University of Georgia
604 Aderhold Hall, Athens, GA 30602-7144 USA
Tel: 706-542-3849, Fax: 706-542-4032, E-mail: treeves@coe.uga.edu

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Abstract: Serious critics of media and technology in education must be answered. The response provided in this paper concludes that: 1) media and technology are best used as cognitive tools to learn with rather than as surrogate teachers, 2) media and technology are only vehicles for the content and pedagogy that educators design into them, and 3) future efforts to integrate media and technology into education must be guided by stronger research and evaluation.

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Introduction

In the United States of America, the degree of federal government support for the development and use of media and technology in education has never been stronger than it is today. For example, in his 1997 State of the Union address, President Clinton said:

> Now, looking ahead, the greatest step of all - the high threshold of the future we now must cross - and my number one priority for the next four years is to ensure that all Americans have the best education in the world. Let's work together to meet these three goals: Every 8-year-old must be able to read; every 12-year-old must be able to log on to the Internet; every 18-year-old must be able to go to college; and every adult American must be able to keep on learning for a lifetime.

Overlooking the fact that the quote above actually contains four goals, not three, all of President Clinton's priorities for his second term of office have direct relevance to media and technology in education. First, the ability to read in the 21st Century demands the development of new forms of media literacy. Negroponte describes the Internet as a place where "children are heard and not seen" [Negroponte, 1995, p. 202]. He predicts that the reading and writing skills of Internet savvy students will improve because "Children will read and write on the Internet to communicate, not just to complete some abstract and artificial exercise" (p. 202). The importance of media and technology in the development of the "new literacy" is obvious.

The second goal regarding Internet access for 12-year-old children has an even more obvious connection to support for media and technology in education. The push to wire all K-12 schools in the USA with full Internet access is proceeding at a rapid rate. According to an Educational Testing Service report, 64% of U.S. schools now have Internet access, and all U.S. schools, and more importantly, many of the classrooms within them, will be "wired" by the year 2000 [Coley et al., 1997]. Of course, whether students and teachers will be prepared to utilize the power of the Internet to support learning remains to be seen.

Third, with respect to higher education opportunities for 18-year-olds, it must be recognized that gaining entrance to higher education is just the beginning. Succeeding there is increasingly unlikely without media and technology skills unimagined in academe even a few years ago. Many university faculty have stopped romanticizing the lecture and are acknowledging the powers of multimedia to provide effective interactive learning opportunities. In fact, many U.S. universities have defined a minimum set of technology skills expected of all students before they enter postsecondary courses, as well as for faculty before they begin to teach [Harrison and Stephen, 1996]. Of course, if students are to enter higher education

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possessing robust media and technology skills, they must begin to develop these skills while they are still in K-12 schools.

Fourth, lifelong learning is rapidly changing from a "buzzword" to a mainstream expectation in business, industry, government, and other spheres of human activity. Winslow and Bramer from Andersen Consulting describe integrated performance support systems as essential to the levels of workplace performance required of all workers in organizations that hope to compete in a global economy [Winslow and Bramer, 1994]. They maintain that these support systems must be "multisensory," integrating a variety of media appropriate to the task to be learned or performed. Lifelong learners won't possess the necessary skills and experience with multiple forms of media unless schools include appropriate learning opportunities across the curriculum.

Given the increased investments in technology in education at the federal level in the USA, it is not surprising that educational media and technology are being subjected to severe criticisms by some. These critiques must not be ignored because critical analysis plays an essential role in a democratic society. Hence, the goal of this paper is not to dismiss critics of educational innovations, but to respond to the doubts expressed by three vocal critics of media and technology in education in a responsible manner. These critics render a great service by forcing us to examine our assumptions about media, technology, and education.

Future Schlock

In a cover story titled "Future Schlock" in the March 1997 issue of *Phi Delta Kappan*, Lawrence Baines, a professor at Florida State University, protests the "platitudes and fabrications" that underlie much of what is being proposed in the name of educational reform [Baines, 1997]. He is especially harsh on technology as a reform vehicle, listing as "Fabrication 1," the statement that "Technology is a moral imperative that will increase student achievement and make American students globally competitive" (p. 494). Baines concludes by proclaiming as "Reality" that "Technology can make learning more fun, easier, and cleaner. But no data supports the conclusion that technology causes gains in student achievement" (p. 495).

Baines' reality statement has a grain of truth in it, but it is ultimately misleading. Researchers have failed to reveal "causal" explanations for the impact of technology on learning, but that is because educational research, like all social sciences, is often limited to discovering relationships rather than revealing definitive causal explanations. However, there are hundreds of studies that support the impact of media and technology on achievement [Jonassen, 1996]. For example, meta-analyses of computer-based instruction (CBI) studies have revealed modest, but positive relationships between technology and achievement at all levels of education: elementary (0.47), secondary (0.36), higher (0.26), and adult (0.42) [Kulik, 1994]. Of course, it must be admitted that the average effect sizes for technologies such as CBI do not approach the two-sigma (2.00) difference often promised by commercial interests and other proponents of technology in education. Nonetheless, positive results are dominant in the research literature, as summarized in a 1997 report from the Educational Testing Service (ETS) titled *Computers and Classrooms* [Coley et al., 1997]:

> [CBI] can individualize instruction and give instant feedback to students, even explaining the correct answer. The computer is infinitely patient and non-judgmental. This motivates students to continue.... Students usually learn more in classes in which they receive computer-based instruction. Students learn their lessons in less time with computer based instruction. Students also like their classes more when they receive computer help in them. (p. 35)

Another misleading aspect of Baines statement is that he fails to point out that his critique is limited to studies that have examined the effects of learning "from" computers. Baines appears unaware of the evidence indicating that it may be more effective to engage students in learning "with" computers than "from" them. In most existing applications of computers in education, content and instruction are encoded by specialists such as instructional designers into predefined educational communications

intended to transmit knowledge to students. Students are expected to receive these communications passively with occasional artificial interactions to let the computer know they are ready to receive more information. In this approach, students are expected to learn "from" computers which have been cast in the role of a surrogate instructor. An alternative approach involves using computers as "cognitive tools" that students learn "with" in a cognitive partnership [Jonassen and Reeves, 1996]. Cognitive tools refer to technologies, tangible or intangible, that enhance our cognitive powers during thinking, problem-solving, and learning. Cognitive tools have been around ever since primitive humans used piles of stones, marks on trees, or knots in vines to calculate sums or record events. Something as simple as a grocery list or as complex as calculus can be regarded as a cognitive tool in that each allows us to "off-load" memorization or other mental tasks onto "technology." Computers are extremely powerful cognitive tools. When software programs are used as cognitive tools in education, students use software to analyze complex problems, solve difficult tasks, access information, interpret and organize their personal knowledge, devise unique solutions, and represent what they have learned to others.

Although research studies on using media and technology as cognitive tools are relatively scarce, the results are often notable [Jonassen and Reeves, 1996]. For example, Lehrer has studied the use of multimedia construction software by eighth graders designing their own lessons about the American Civil War [Lehrer, 1993]. His work exemplifies the principle that: "Cognitive tools empower learners to design their own representations of knowledge rather than absorbing knowledge representations preconceived by others." Students in one of Lehrer's studies were high and low ability eighth graders who worked at the multimedia construction tasks for one class period of 45 minutes each day over a period of ten weeks. The students worked in a media center where they had access to computers, a scanner, sound digitizer, multimedia construction software, and numerous print and non-print resources about the Civil War. A teacher was available to coach students in the conceptualization, design, and production of their programs. Students created programs reflecting their unique interests. For example, they created multimedia about the role of women in the Civil War, the perspectives of slaves toward the war, and "not-so-famous people" from that period. According to Lehrer, "The most striking finding was the degree of student involvement and engagement" (p. 209). All students became task-oriented, increasingly so as they gained more autonomy and confidence with the cognitive tools. At the end of the study, students in the multimedia group and a control group of students who had studied the Civil War via traditional classroom methods during the same period of time were given an identical teacher-constructed test. No significant test differences were found. However, a year later, when students in the design and control groups were interviewed by an independent interviewer unconnected with the previous year's work, important differences were found. Students in the control group could recall almost nothing about the historical content, whereas students in the design group displayed elaborate concepts and ideas that they had extended to other areas of history, Most importantly, although students in the control group defined history as the record of the facts of the past, students in the design class defined history as a process of interpreting the past from different perspectives. In short, the cognitive tool approach lead to knowledge that was richer, better connected, and more applicable to subsequent learning and events. After this and other studies, Lehrer concluded that: 1) by using multimedia as cognitive tools, students' on-task behavior increased over time, 2) they perceived the benefits of planning and modifying their work during different stages of development, and 3) they developed generalizable skills such as taking notes, finding information, coordinating their work with other team members, writing interpretations, and designing presentations.

In an extensive review of the literature [Jonassen and Reeves, 1996], the theoretical foundations for using computers as cognitive tools are summarized:

- Cognitive tools are most effective when they are applied within constructivist learning environments.
- Cognitive tools empower learners to design their own representations of knowledge rather than absorbing the representations preconceived by others.
- Cognitive tools can promote the deep reflective thinking that is necessary for meaningful learning.

- Cognitive tools enable mindful, challenging learning rather than the effortless learning promised but rarely realized by other instructional technologies.
- Cognitive tools should be applied to tasks or problems defined by learners with the support of their teachers.
- Cognitive tool use for education should be situated in realistic contexts with results that are personally meaningful for learners.
- Cognitive tools can enable intellectual partnerships in the form of distributed cognitive processing. (p. 698)

The Computer Delusion

Perhaps the most talked-about attack on media and technology in education this year has been Todd Oppenheimer's cover story, "The Computer Delusion," published in the July 1997 issue of *The Atlantic Monthly* [Oppenheimer, 1997]. Oppenheimer starts his critique by reciting some of the overly optimistic predictions made about the educational benefits of earlier technologies such as film, radio, television, programmed instruction, teaching machines, etc. For example, he notes that Thomas Edison predicted that "the motion picture is destined to revolutionize our educational system and....in a few years it will supplant largely, if not entirely, the use of textbooks" (p. 45). Such predictions have always been easy targets, and there are no shortage of similar targets today. Consider this quote from Lewis Perelman's book *School's Out* [Perelman, 1992].

> Because of the pervasive and potent impact of HL (hyperlearning) technology, we now are experiencing the turbulent advent of an economic and social transformation more profound than the industrial revolution. The same technology that is transforming work offers new learning systems to solve the problems it creates. In the wake of the HL revolution, the technology called "school" and the social institution commonly thought of as "education" will be as obsolete and ultimately extinct as the dinosaurs. (p. 50)

With hyperbole like Perelman's, is it really surprising that pundits like Oppenheimer have concluded that many of us are blinded by technology? Ironically, Oppenheimer appears to exaggerate as much as Perelman, albeit in the opposite direction. For example, by taking quotes out of context and citing a few dubious studies, Oppenheimer claims that computers threaten to diminish the reading, writing, and self-expression skills of students while at the same time crushing their imaginations and stunting their socialization. The major thrust of Oppenheimer's critique is that "school districts are cutting programs - music, art, physical education - that enrich children's lives to make room" for computers while "there is no good evidence that most uses of computers significantly improve teaching and learning" (p. 45).

As with Baines critique, Oppenheimer's attack contains a little truth and a great deal of misinformation. Instead of being non-existent, the evidence of the effects of using computers in a tutorial mode is generally positive, albeit modest [Kulik, 1994]. However, when computers are used to enable innovative pedagogical approaches, results are impressive. For example, consider Apple Classrooms of Tomorrow (ACOT) project, a decade long initiative to introduce computers and associated media into schools and homes. The simple presence of technology and media had little impact in ACOT schools, but when the technology was used to enable enhanced pedagogical strategies such as project-based learning, collaboration, and extended time-on-task, the outcomes were quite positive [Fisher et al., 1996]. The results are summarized in an Educational Testing Service Report [Coley et al., 1997] as:

> ACOT students:
> - Explored and represented information dynamically and in many forms
> - Communicated effectively about complex processes
> - Used technology routinely and appropriately
> - Became independent learners and self-starters
> - Knew their areas of expertise and shared their expertise spontaneously
> - Worked well collaboratively
> - Developed a positive orientation to the future (p. 37)

Oppenheimer argues that it is the improved teaching and learning strategies that make the difference in success stories like ACOT, not the technology. He is correct that the enhanced pedagogy is what matters most [Clark, 1994], but he fails to recognize that such pedagogical enhancements would be impossible without the capabilities of new technology [Kozma, 1994]. The reality is that in most schools, technology is an essential vehicle for pedagogical change.

The End of Education

Neil Postman is probably the best known critic of media and technology in education. In *The End of Education*, Postman has taken educators to task for the adopting new technologies without questioning their impact on the basic goals and processes of education [Postman, 1995]. For example, Postman wrote:

> I do not go as far back as the introduction of the radio and the Victrola, but I am old enough to remember when 16-millimeter film was to be the sure cure, then closed-circuit television, then 8-millimeter film, then teacherproof textbooks. Now computers. I know a false god when I see one. (p. 50)

One response to Postman's concerns is that he too is focusing on media and technology as things that students learn *from* rather than tools that they learn *with*. This is hardly surprising given that most of the commercial advertisements promoting the use of media and technology in education emphasize the "from" approach. For example, a recent brochure from Macromedia, the company the markets popular authoring systems such as Authorware and Director, has the following message on its cover: "To better reach your students, don't change your message." Upon opening the brochure, the following message appears in ever bolder type: "Change your medium." The belief that the same old content and instructional strategies will somehow be transformed by delivering them via the latest media and technology is widespread in education, and Postman, Oppenheimer, Baines, and others are wise to question the validity of this approach. Significant educational improvements are more likely to stem from changes in the message (i.e., content and pedagogy) than merely switching to another medium.

Although often castigated as an Information Age Luddite, Postman actually concludes his *The End of Education* book with support for the integration of "technology education" into schools [Postman, 1995]. He defines technology education as a subject in which students address questions such as:

> How does information differ in symbolic form? How do ideographs differ from letters? How are images different from words? Paintings from photographs? Speech from writing? Television from books? Radio from television? Information comes in many forms, and at different velocities and in different quantities. Do the differences matter? Do the differences have varying psychic and social effects? The questions are almost endless. This is a serious subject. (p. 190)

Postman's conception of technology education stands in sharp contrast with more common approaches to technology education that are centered on the teaching of how to use technology. There are only a handful of schools where media and technology are considered as important subjects of disciplined study in and of themselves. Several notable experiments are highlighted in *Brave New Schools* [Cummins and Sayers, 1995]. For example, they describe an electronic telecommunications project at Cold Spring Harbor High School in New York in which U. S. students engaged Israeli and Palestinian students in a dialog about how the news media cover events in the Middle East with either a pro-Israeli or pro-Palestinian bias. The words of one of the participating students conveys the power of this experience:

> I have had the opportunity to accomplish what many other students may never even have a chance to attempt. Even though I do not have the influence to reverse the sometimes harsh sentiments of the people, I would like to come away thinking that at least I did something to help the peace process along.... Many people do not have the opportunity to tap directly into the minds and hearts of their peers who live thousands of miles away in troubled lands. I am very thankful to have worked on a project that has strengthened my communication skills and provided me with some of the most valuable lessons one can learn in life. (p. 76)

Although it is difficult to agree with Postman's conclusion that computers and other technologies are false gods, his concerns for the social and psychological effects of media must not be ignored. Technology affords us many benefits, but rarely without some hidden or unexpected costs. The examination of these costs within educational contexts is an important enterprise.

Conclusion

What can be concluded from this brief response to three of the major criticisms aimed at media and technology in education in the USA? My conclusions are in agreement with those of the Panel on Educational Technology that was part of the U. S. President's Committee of Advisors on Science and Technology. The Panel made the following recommendations [President's Committee of Advisors on Science and Technology, 1997]:

1. Focus on learning with technology, not about technology.
2. Emphasize content and pedagogy, and not just hardware.
3. Give special attention to professional development.
4. Engage in realistic budgeting.
5. Ensure equitable, universal access.
6. Initiate a major program of experimental research.

Numbers 1, 2, and 6 above are especially in sync with my own conclusions. Technology is best used as a cognitive tool to learn *with* rather than as a surrogate teacher. Pedagogy and content matter most; technology and media are only vehicles, albeit powerful ones. Most importantly, future efforts to use media and technology in schools must be guided by much more rigorous research and evaluation than in the past.

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